

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
31 July 2003 (31.07.2003)

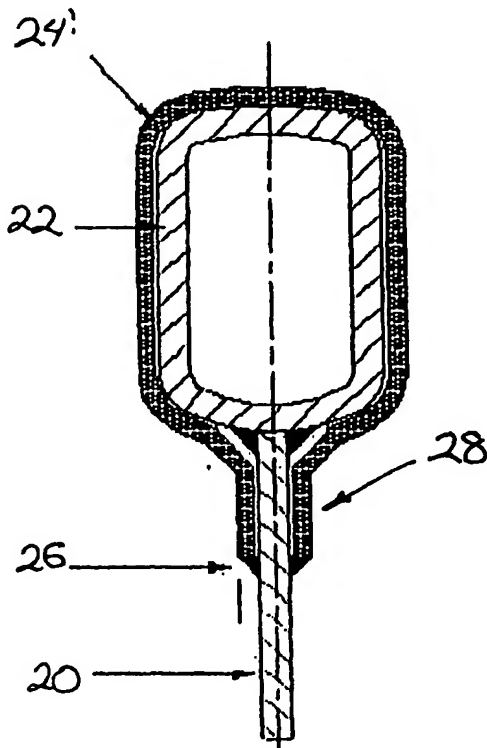
PCT

(10) International Publication Number
WO 03/062497 A1

- (51) International Patent Classification⁷: **C25C 7/02** (74) Agent: **BALDWIN SHELSTON WATERS**; 60 Margaret Street, Sydney, NSW 2000 (AU).
- (21) International Application Number: **PCT/AU03/00086**.
- (22) International Filing Date: 28 January 2003 (28.01.2003) (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: *25 July 04*
PS 0159 25 January 2002 (25.01.2002) AU
- (71) Applicant (*for all designated States except US*): **MOUNT ISA MINES LIMITED** [AU/AU]; 410 Ann Street, Brisbane, QLD 4000 (AU).
- (72) Inventor; and
- (75) Inventor/Applicant (*for US only*): **WEBB, Wayne, Keith** [AU/AU]; 75 Thirteenth Avenue, Railway East, QLD 4810 (AU).
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: HANGER BAR



(57) Abstract: A hanger bar (22) for a cathode plate (20) and a method of producing a cathode (1) for electrolytic recovery of metal. The hanger bar comprises a support element (22) which is preferably stainless steel and hollow. An electrically conductive metal cladding (24) is affixed the stainless steel bar by any appropriate mechanism, eg interference fit, welding, chemical or mechanical fastening or coextrusion or roll forming. Affixing the cladding to the stainless steel support element has significant advantages over conventional electroplating techniques including that a more precise engineering specification can be applied to the cladding thickness. This is important to maintain vertical alignment of the cathode plate in the electrolytic cell.

BEST AVAILABLE COPY



WO 03/062497 A1

**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent*

(AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

- *of inventorship (Rule 4.17(iv)) for US only*

Published:

- *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

- 1 -

Title: HANGER BAR**Technical Field**

The present invention relates to cathodes used in electrolytic recovery of metals.

Background Art

5 Any discussion of the prior art throughout the specification should in no way be considered as an admission that such prior art is widely known or forms part of common general knowledge in the field.

There are various processes and apparatus for electro-refining or electro-winning of metal. One particularly successful process for electro-depositing of copper, for
10 example, is the so called ISA PROCESS. In this process, stainless steel cathode mother plates are immersed in an electrolyte bath with copper anodes. The copper from the anodes dissolve into the electrolyte and are subsequently deposited in a refined form onto the blade of the mother plate. The electrolytically deposited copper is then stripped from the blade by first flexing the cathode plate to cause at least part of the copper
15 deposit to separate from the blade, and then wedge stripping or gas blasting the remainder of the copper from the blade.

The cathode mother plate generally consists of a stainless steel blade, and a hanger bar connected to the top edge of the blade to hold and support the cathode in the electrolytic bath.

20 There are a wide variety of hanger bar constructions. Early cathode plates used solid copper hanger bars which provided not only excellent electrical conductivity but adequate strength to support both the cathode plate and the metal deposited thereon. It was discovered, however, that under repeated use both in the electrolytic bath and in the stripping machinery the relatively ductile copper bar tended to bend or be damaged.

25 In addition, connection of the stainless steel blade to the copper hanger bar was sometimes difficult. To overcome this difficulty, complex construction and welding techniques were required. In one instance, as discussed in US Patent No 5492609, additional parallel grooves were machined in the hanger bar on either side of the central groove which accepts the cathode blade. The cathode blade and the hanger bar were
30 then welded together along this inset groove, the ridges formed between the parallel grooves and the sheet then being used as welding material. This process sometimes required the copper hanger bar and steel cathode blade to be welded in a thermally conductive liquid to maintain the bar at a constant uniform temperature.

- 2 -

The cost, complexity and durability of the copper hanger bar led the industry to use iron or steel hanger bars for greater structural strength. In most cases, while structural integrity was good, the iron or stainless steel was a poor conductor of electricity. Accordingly, in another technique a coating of electrically conductive metal was electrolytically deposited on the hanger bar. Such iron or steel hanger bars with electrolytically deposited conductive metal, came in various shapes such as simple solid beams, I-beams or hollow sections.

Once again, however, it was found that these new configurations had their own difficulties. Firstly, such a coating technique only permits tolerances within the technical limitation of the electroplating process. The thickness and adhesion of the metal coating is additionally limited by the electroplating process.

It is an object of the present invention to overcome or ameliorate at least one of the disadvantages of the prior art, or to provide a useful alternative.

Disclosure of the Invention

In a broad aspect, the present invention provides a hanger bar for a cathode plate used in electrolytic recovery of metal comprising a corrosion resistant support element adapted for connection to a blade of the the cathode plate, at least a portion of said support having an electrically conductive metal cladding affixed thereto.

The support element should be resistant to corrosion in the environment of use, ie in the electrolytic bath. Preferably, the corrosion resistant support element is made from stainless steel and is preferably hollow.

The electrically conductive metal cladding may be affixed to and cover a portion or the entire exterior of the stainless steel support. This is accomplished by any suitable technique eg an interference fit, welding, chemical or mechanical fastening, roll forming, etc.

The use of stainless steel as the support element imparts strength, long term durability and corrosion resistance for the hanger bar. These features are clearly important in obtaining an extended operational life for the hanger bar. However, as is well known in the art, stainless steel is a relatively poor electrical conductor. The introduction of an electrically conductive metal cladding will permit the ready transfer of electrical current along the hanger bar into the blade of the cathode plate.

However, unlike the prior art this electrical conductivity is achieved by affixing a cladding of electrically conductive material. Mechanically fitting the cladding permits a

- 3 -

more precise engineering specification to be applied to the cladding thickness and consequently aids in the maintaining vertical alignment of the cathodes in the electrolytic cells. As discussed above, tolerances now required for operation of electrolytic cells at high current density cannot be easily achieved by other conventional mechanisms such as electroplating of the stainless steel hanger bar.

In addition, the necessary strength for the hanger bar cannot be obtained from the use of copper alloy within the hanger bar construction.

In a preferred embodiment, the electrically conductive cladding surrounds the exposed portions of the support element, and extends part way down from the support element along the blade of the cathode. This embodiment reduces the electrical resistance to current passing through the bar onto the blade and in addition reduces the possibility of bi-metallic corrosion of the joint between the electrically conductive metal and the cathode blade which is normally made from stainless steel.

In addition to the aforementioned advantages arising from use of the hanger bar, the production of the hanger bar itself is much simpler than conventional mechanisms. For instance, it is not necessary to use a portion of the hanger bar as weld material. Nor is it necessary to electroplate the hanger bar. As will be known to persons skilled in the art, in one conventional technique, for production of the cathode plate, after the hanger bar is welded to the cathode blade, the entire assembly is inverted and dipped into an electrolytic bath a sufficient depth to electroplate the hanger bar with a conductive metal. The cost and handling difficulties associated with this mechanism are clear. Affixing a cladding of electrically conductive metal to the support element is much simpler, more cost effective and more accurate than current techniques.

In a second embodiment, the present invention provides a method of producing a cathode plate for electrolytic recovery of metal comprising providing a cathode blade, connecting a corrosion resistant support element to the cathode blade and affixing a cladding of electrically conductive metal to the support element.

Unless the context clearly requires otherwise, throughout the description and the claims, the words 'comprise', 'comprising', and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to".

Brief Description of the Drawings

The present invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a front elevational view of a cathode plate incorporating the hanger bar
5 of the present invention,

Figure 2 is a sectional view through section A-A of Figure 1 showing the hanger bar in use according to a first embodiment of the present invention, and

Figure 3 is a cross sectional view showing the hanger bar and cathode blade according to a second embodiment of the present invention.

10 Best Mode for Carrying Out the Invention

As shown in Figure 1, a cathode plate 1 comprises a hanger bar 10 and a cathode blade 20. Windows 15 are cut from the cathode blade 20 to assist in lifting and transportation of the cathode 1.

As mentioned above, when electro-refining copper according to the ISA
15 PROCESS, the cathode blade 20 is a stainless steel blade. However, it will be appreciated that the blade can be manufactured from any suitable material. Titanium and other metals may be used in electro-refining operations.

As shown more clearly in Figure 2, the hanger bar 10 comprises a support element 22 with a cladding 24 of electrically conductive metal affixed thereto.

20 In this embodiment the support element 10 is stainless steel bar. The stainless steel bar 22 is hollow but is preferably sealed at the ends. It is not essential that the stainless steel bar 22 be hollow.

The cladding of electrically conductive material 24, in this example copper, is affixed around the stainless steel bar 22. This sleeve acts to conduct electricity from the
25 electrical connections in the electrolytic bath through the hanger bar to the cathode blade. Typically, the cladding would be around 2 to 4 mm thick.

Welds 26 run along the terminating edge of copper cladding 24 connecting the copper sleeve to the plate/bar assembly. The Applicant has found that any welding material is suitable provided it can withstand the electrolytic environment in which the
30 cathode plate is used. Aluminium bronze and silicone bronze are particularly suitable weld metals.

- 5 -

It should be noted that the cladding may be affixed to the support element by a variety of techniques including interference fit, chemical or mechanical fastening or roll forming.

As shown in Figure 3, the sleeve may include an extension 28 onto the cathode
5 plate 10. The intention of this extension is to reduce electrical resistance between the hanger bar and the copper blade, and reduce bi-metallic corrosion between the hanger bar and the plate. Preferably, this extension terminates on or about the level of windows 23 or 30 to 40 mm above the level of electrolyte.

The Applicants have surprisingly found that affixing the electrically conductive
10 metal cladding to a stainless steel support element has significant advantages over conventional electroplating systems.

The separate manufacture and subsequent affixing of the cladding to the support element provides for closer tolerances and a more precise engineering of the cladding thickness. This is important to maintain vertical alignment of the cathode plate in the
15 electrolytic cell when resting on the electrical connectors either side of the electrolytic bar.

No current process allows such fine tolerances to be applied to the hanger bar construction and as far as the applicant can ascertain this affixing of the electrically conductive sleeve over the stainless steel hanger bar has not been proposed to date.

In addition, having a stainless steel core, the bar will retain long term mechanical
20 strength with ease of manufacture. It will also be appreciated that this construction has advantages in terms of maintenance. For instance, if the sleeve/cladding of conducting material is damaged, it is a simple matter to remove the cladding and replace. This can also be applied to current hanger bars with electrolytic coatings of conductive material.
25 If these coatings are damaged or it is found that the cathode plate is not performing adequately in the cell due to poor alignment, the present invention allows precise tolerances to be applied to the hanger bar not only to repair the hanger bar but provide a more precise engineering of the cladding thickness and hence alignment of the cathode plate in the bar.

The hanger bar and method of production may be embodied in other forms without
30 departing from the spirit or scope of the present invention.

- 6 -

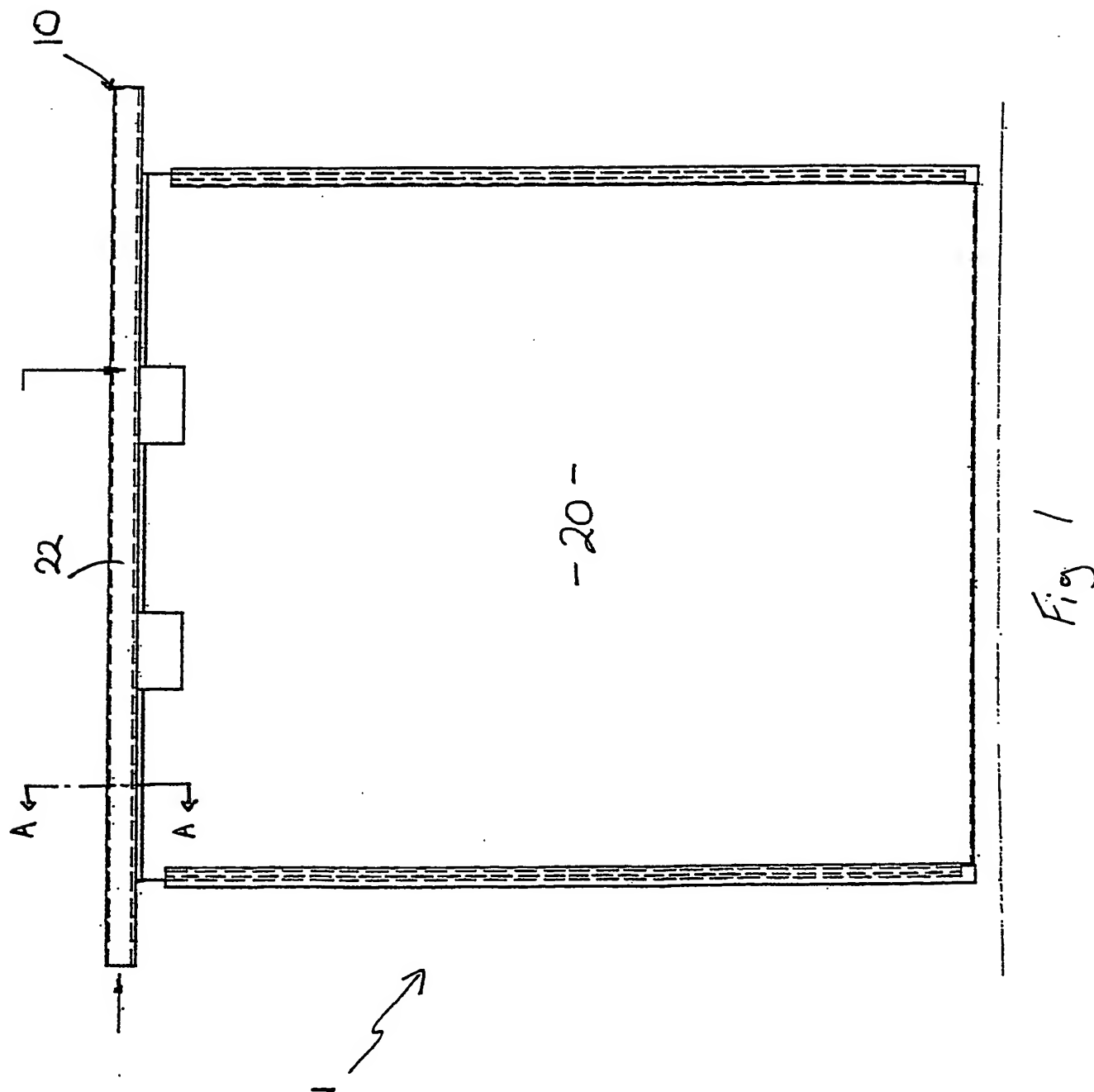
CLAIMS:

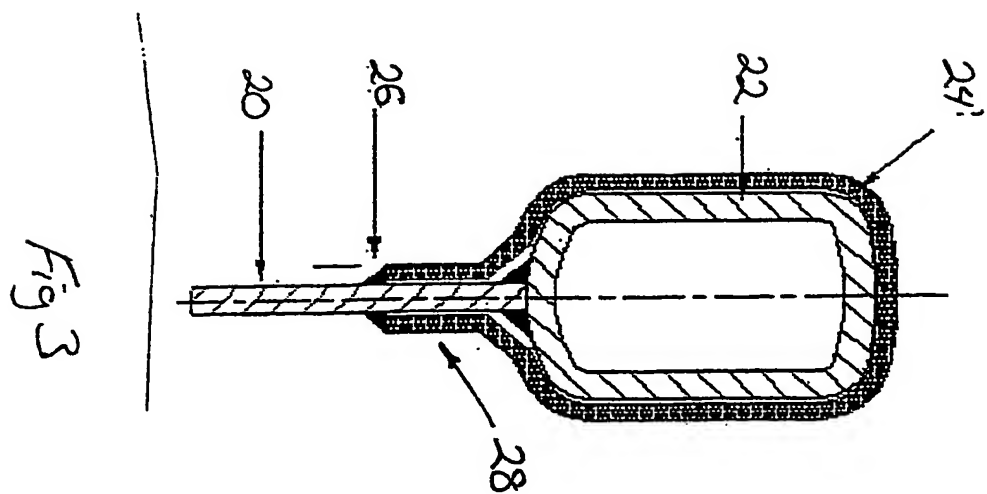
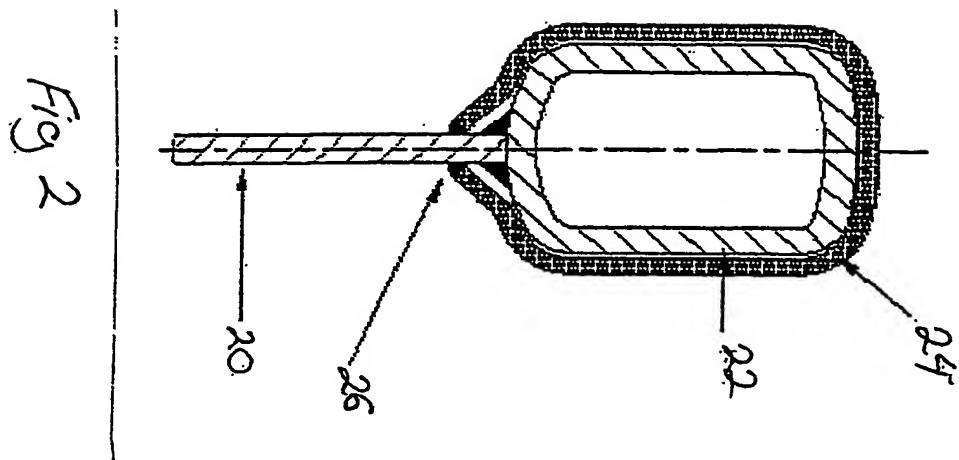
1. A hanger bar for a cathode plate used in electrolytic recovery of metal comprising a corrosion resistant support element adapted for connection to a blade of the cathode plate, at least a portion of said support having an electrically conductive metal cladding
5 affixed thereto.
2. A hanger bar as claimed in claim 1, wherein the support element is constructed from stainless steel.
3. A hanger bar as claimed in claim 1, wherein said support element is hollow.
4. A hanger bar as claimed in claim 1 or claim 2, wherein the electrically conductive
10 metal cladding is affixed such that it covers the entire exterior of the support element.
5. A hanger bar as claimed in any one of claims 1 to 4, wherein the electrically conductive metal cladding is affixed such that it covers a portion of the support element.
6. A hanger bar as claimed in any one of the preceding claims, wherein the electrically conductive metal cladding is affixed by an interference fit.
- 15 7. A hanger bar as claimed in any one of the preceding claims, wherein the electrically conductive metal cladding is affixed by welding.
8. A hanger bar as claimed in claim 7, wherein the electrically conductive metal cladding is welded to the support element and/or cathode blade by aluminium bronze weld.
- 20 9. A hanger bar as claimed in claim 7, wherein the electrically conductive metal cladding is welded to the support element and/or cathode blade by silicone bronze weld.
10. A hanger bar as claimed in any one of the preceding claims, wherein the electrically conductive metal cladding is affixed to the support element by mechanical and/or chemical fastening.
- 25 11. A hanger bar as claimed in any one of the preceding claims, wherein the support element and electrically conductive metal cladding are affixed by coextrusion.
11. A hanger bar as claimed in any one of the preceding claims, wherein the electrically conductive metal cladding is affixed to the support element by roll forming.
12. A hanger bar as claimed in any one of the preceding claims, wherein the
30 electrically conductive metal cladding extends from the support element to the cathode blade and part way down the cathode blade.

- 7 -

13. A hanger bar as claimed in claim 12, wherein the cladding extends from the support element to a position 30 to 40 mm above the level of electrolyte when the cathode blade is placed in an electrolyte bath.
14. A hanger bar as claimed in any one of the preceding claims, wherein the blade is
5 stainless steel.
15. A hanger bar as claimed in any one of the preceding claims, wherein the electrically conductive metal is copper.
16. A method of producing a cathode plate for electrolytic recovery of metal comprising providing a cathode blade, connecting a support element to the cathode
10 blade, said element being adapted to support the cathode plate in an electrolytic bath, and affixing a cladding of electrically conductive metal to the support.
17. A method as claimed in claim 16, wherein the cladding is affixed to the support element after connection of the support element and cathode blade.
18. A method as claimed in claim 16 or claim 17, wherein the cladding is affixed to the
15 support element before connection of the support element to the cathode blade.
19. A method as claimed in any one of claims 16 to 18, wherein the electrically conductive metal cladding is affixed by an interference fit.
20. A method as claimed in any one of claims 16 to 19, wherein the electrically conductive metal cladding is affixed by welding.
- 20 21. A method as claimed in claim 20, wherein the electrically conductive metal cladding is welded to the support element and/or cathode blade by aluminium bronze weld.
22. A method as claimed in claim 20, wherein the electrically conductive metal cladding is welded to the support element and/or cathode plate by silicone bronze weld.
- 25 23. A method as claimed in any one of claims 15 to 20, wherein the electrically conductive metal cladding is affixed by chemical or mechanical fastening.
24. A method as claimed in any one of claims 15 to 22, wherein the support and electrically conductive metal cladding are affixed by roll forming.
25. A method as claimed in any one of claims 15 to 24, wherein the cathode blade
30 and/or support element are constructed from stainless steel.
26. A method as claimed in any one of claims 15 to 25, wherein the electrically conductive metal is copper.

1/2





INTERNATIONAL SEARCH REPORT

 International application No.
PCT/AU03/00086

A. CLASSIFICATION OF SUBJECT MATTER		
Int. Cl. 7: C25C 7/02		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) IPC C25C 7/02		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) DWPI IPC + KEYWORDS (CLAD, COAT, BAR, HANG, CONDUCT, COPPER)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4186074 A (PERRY) 29 January 1980 See entire document	1-26
X	Derwent Abstract Accession No.94-075737/10 , Class X25, DE 4241485 C (SIEMENS AG) 17 March 1993 & DE 4241485 See entire document	1, 3-4, 6-11, 15-16, 18-26
X	US 4882027 A (BORST et al.) 21 November 1989 See entire document	1-2, 4, 14-16, 18-26
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 5 March 2003		Date of mailing of the international search report 12 MAR 2003
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929		Authorized officer R.P. ALLEN Telephone No : (02) 6283 2134

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU03/00086**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent Abstract Accession No. 93-262108/33, Class M28, JP 05-179478 A (SHINKO METAL PROD KK) 20 July 1993 & JP 05-179478 A See abstract and figures	1, 4, 14, 16, 18, 25
X	WO 01/63013 A (OUTOKUMPU OYJ) 30 August 2001 See entire document	1, 16, 18, 25
X	WO 00/39366 A (RSR TECHNOLOGIES INC) 6 July 2000 See entire document	1, 4, 12
A	US 4373654 A (PRENGAMAN et al.) 15 February 1983 See entire document	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU03/00086

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
US	4186074	NONE					
DE	4241485	NONE					
US	4882027	CA	1263627	NO	870406		
JP	5179478	NONE					
WO	200163013	AU	200140717	BR	200108540	EP	1257692
		FI	20000411	US	2003010630		
WO	200039366	EP	1147247	US	6131798		
US	4373654	AU	77394/81	CA	1172994	EP	53377
		ES	507212	ES	8303548	ES	516541
		ES	8307928	JP	57116793	MX	159891
		NO	813978	ZA	8107897		
END OF ANNEX							

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☒ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.